

Validation of TES Profiles using Radiance Closure Analysis

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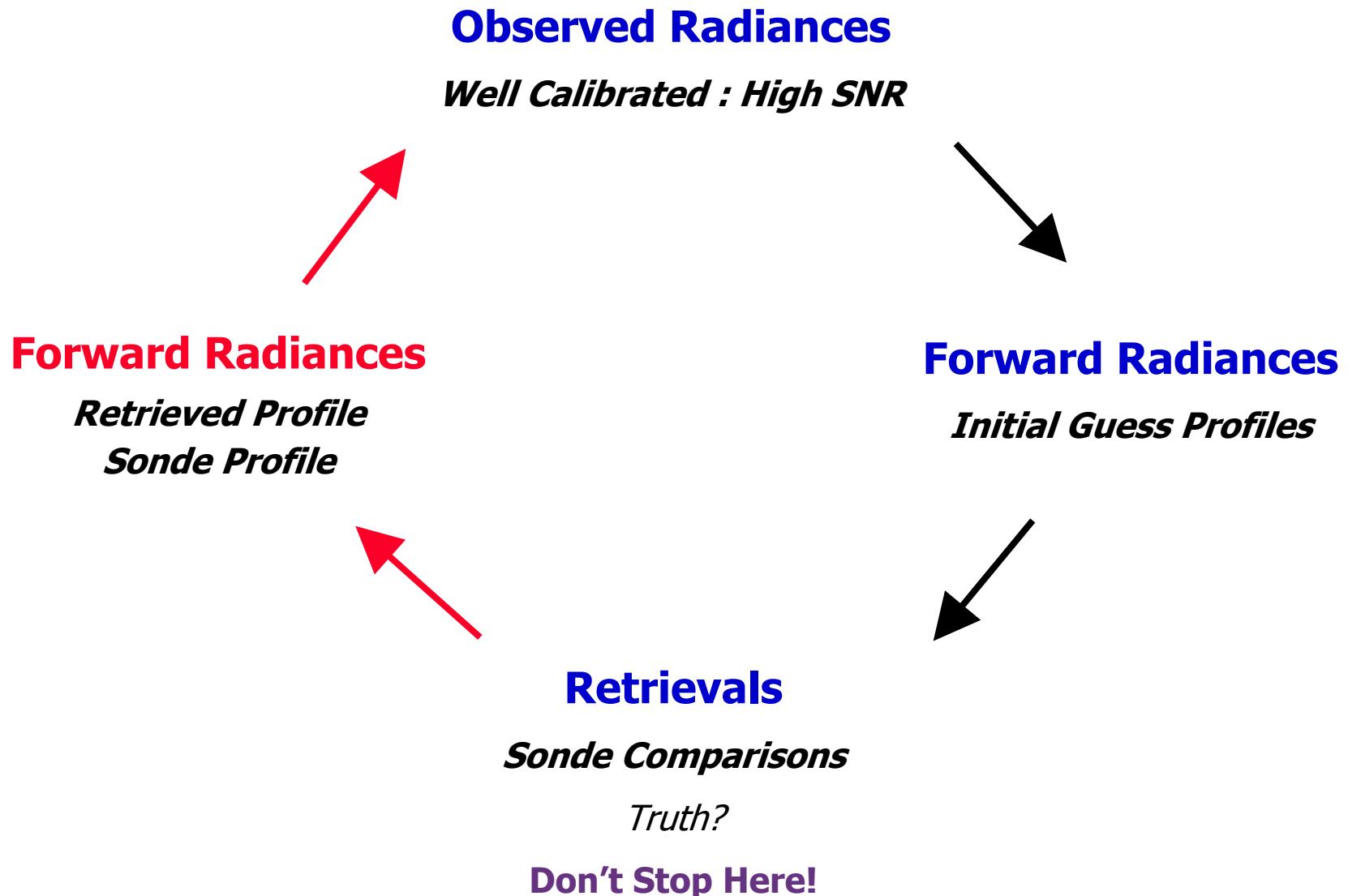
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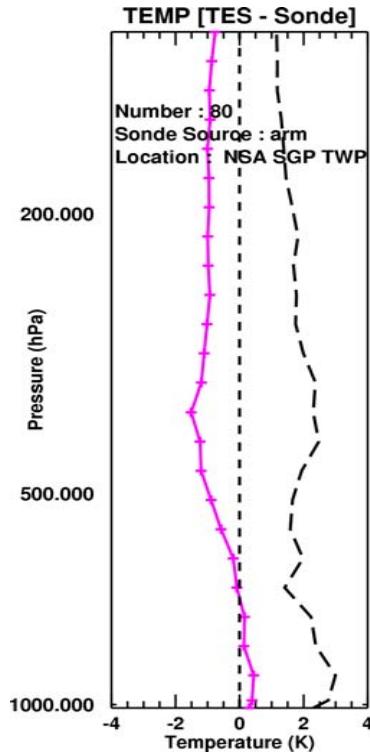
What is a Radiance Closure Study?



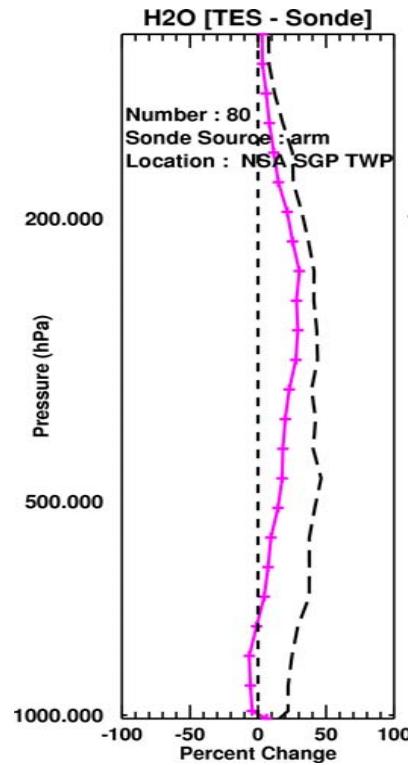
TES ARM Profile Comparison

ARM sites well instrumented

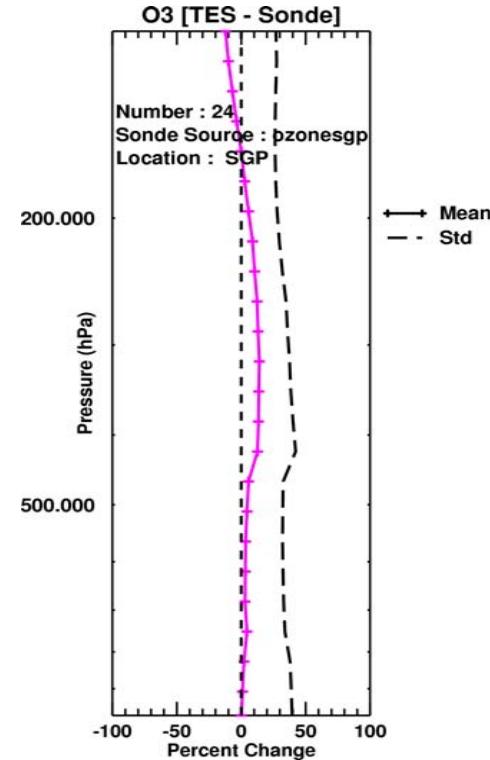
- **T and H₂O (within 2 hrs and 250 km): AIRS validation 80 radiosondes**
 - » North Slope Alaska (NSA), Southern Great Plains (SGP), Tropical Western Pacific (TWP)
- **Ozone (within 1 hr. and 50 km) : SGP TES validation 24 ozonesondes**
- **Applied TES averaging kernels to the sonde profiles**



TES cooler



TES moist



TES slightly higher

ARM SGP Radiance Comparison Example

Forward Radiances

Initial Guess Profile

TES Retrieved Profile

Ozonesonde Profile

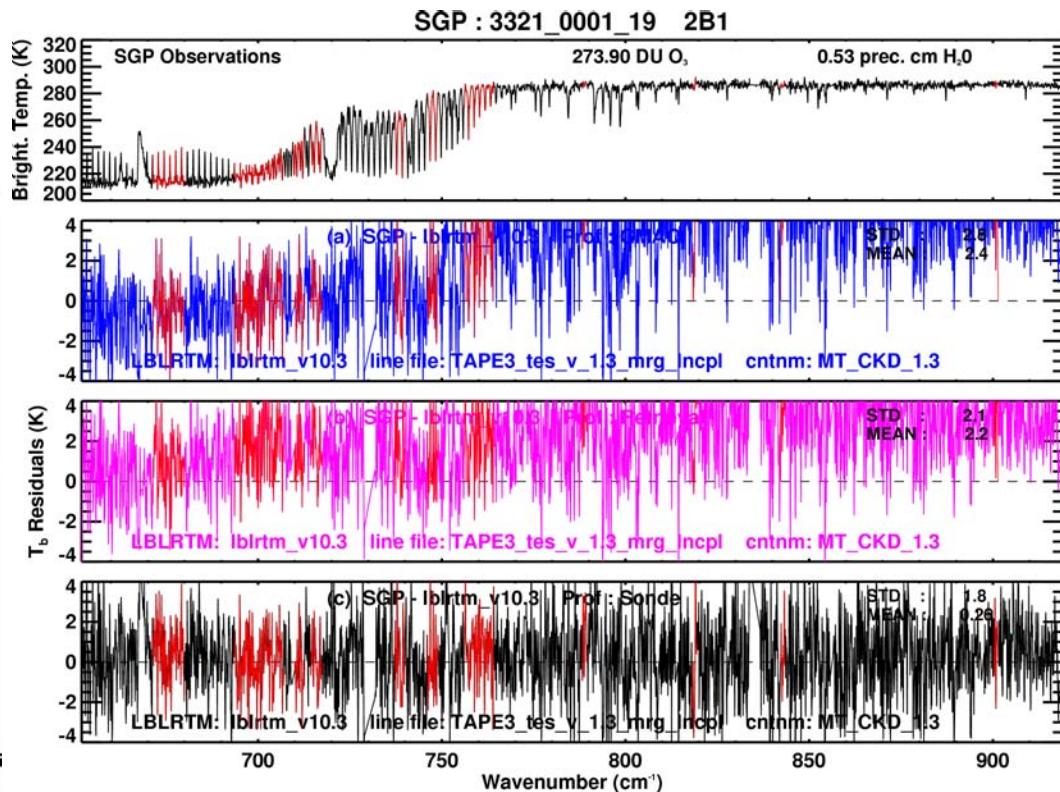
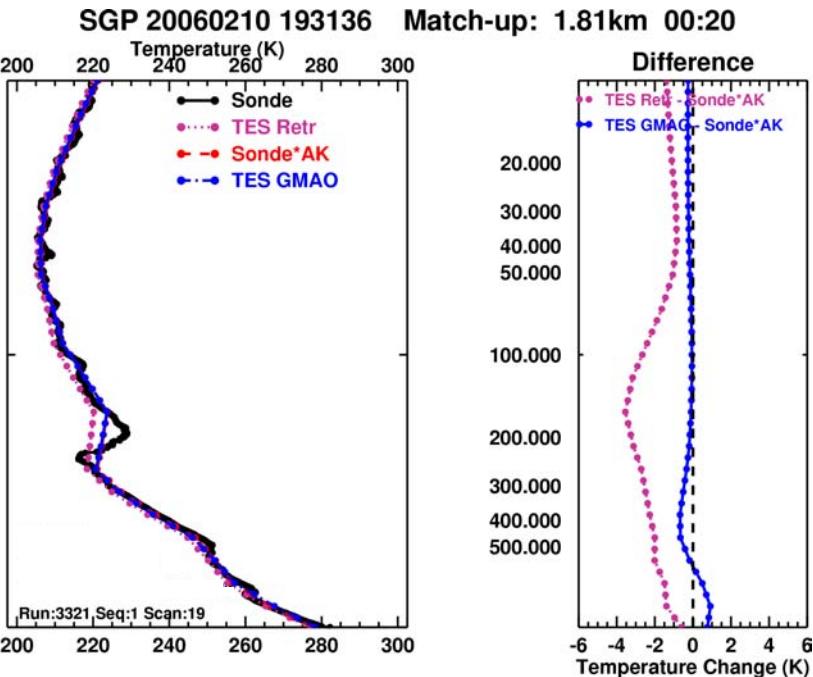


TES Observed Radiances

- **TES Initial Guess Profile:**
 - Profile and Surface Temperature: GMAO
 - Water Vapor : GMAO
 - Ozone: MOZART Climatology
 - Emissivity: Land surface type
- **TES Retrievals (Version 2):**
 - Simultaneous temp., H_2O , O_3 , emissivity (land), surf. temp.
 - TES Match-up Observation : 1.8km away and 20mins after ozonesonde launch and over land
- **Ozonesonde launched from the ARM SGP site for AURA validation:**
 - Feb. 10, 2006 : 19:31 UTC : clear sky conditions
 - GMAO attached to top of the profile (or 200 mb water vapor)
 - Emissivity: ARM SGP emissivity : linear combination of pasture and soil

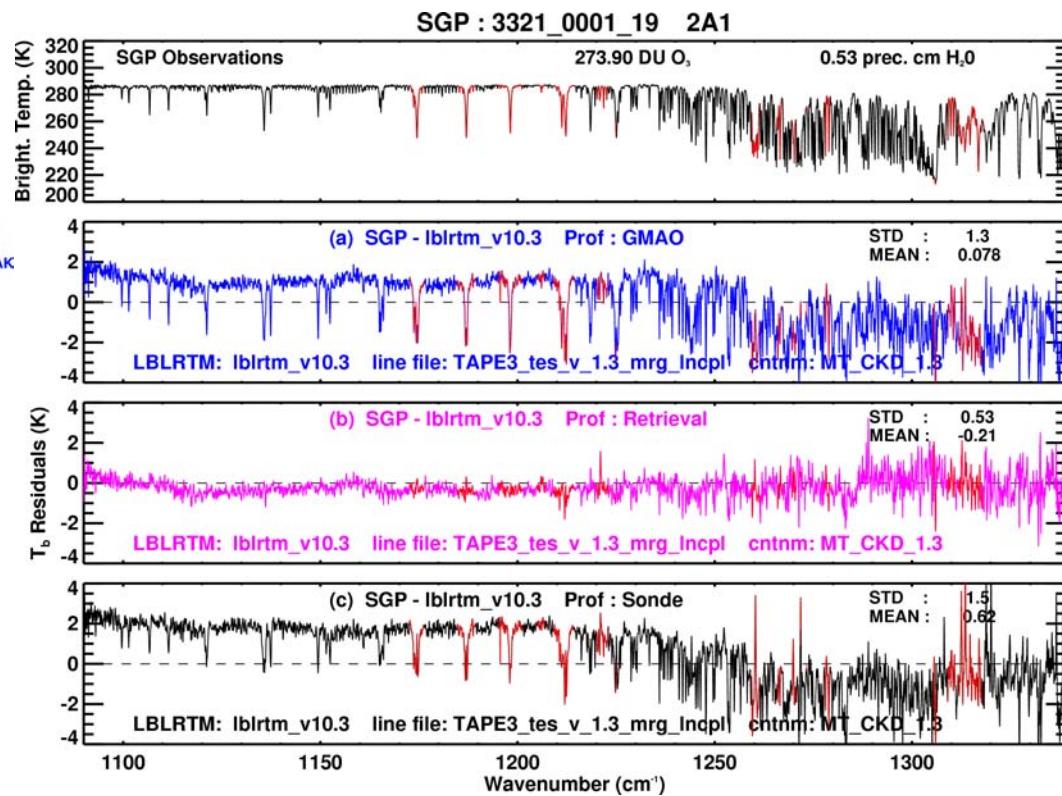
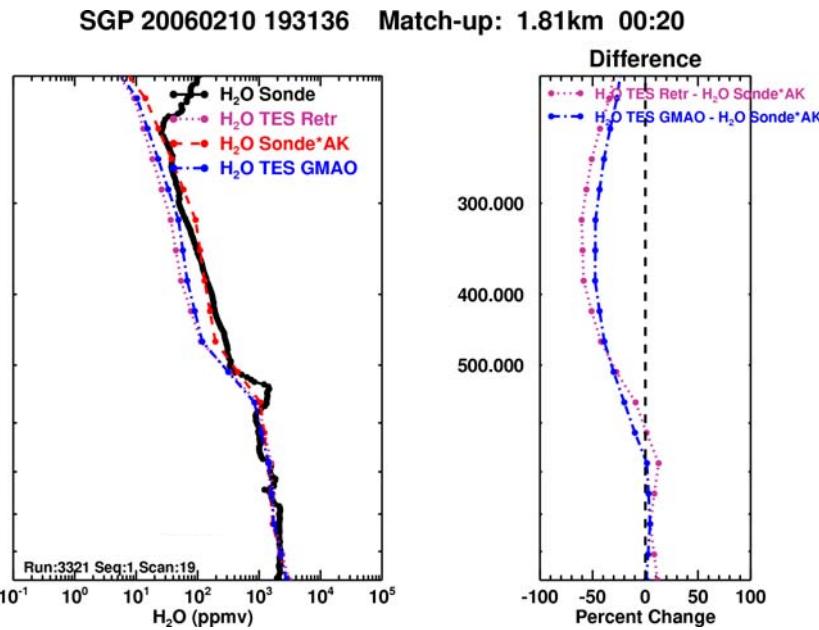
TES Temperature

- Version 2 temperature retrieval
 - Uses water vapor (1250 cm^{-1}) and ozone (1050 cm^{-1}) regions
 - Retrieval residuals (Obs. - Calc.) CO₂ region
 - » positive : retrieved temperatures are cool: inconsistency
 - Sonde residuals closer to zero : nearer to the true atmospheric state
- Version 3 retrievals will include microwindows in this CO₂ region



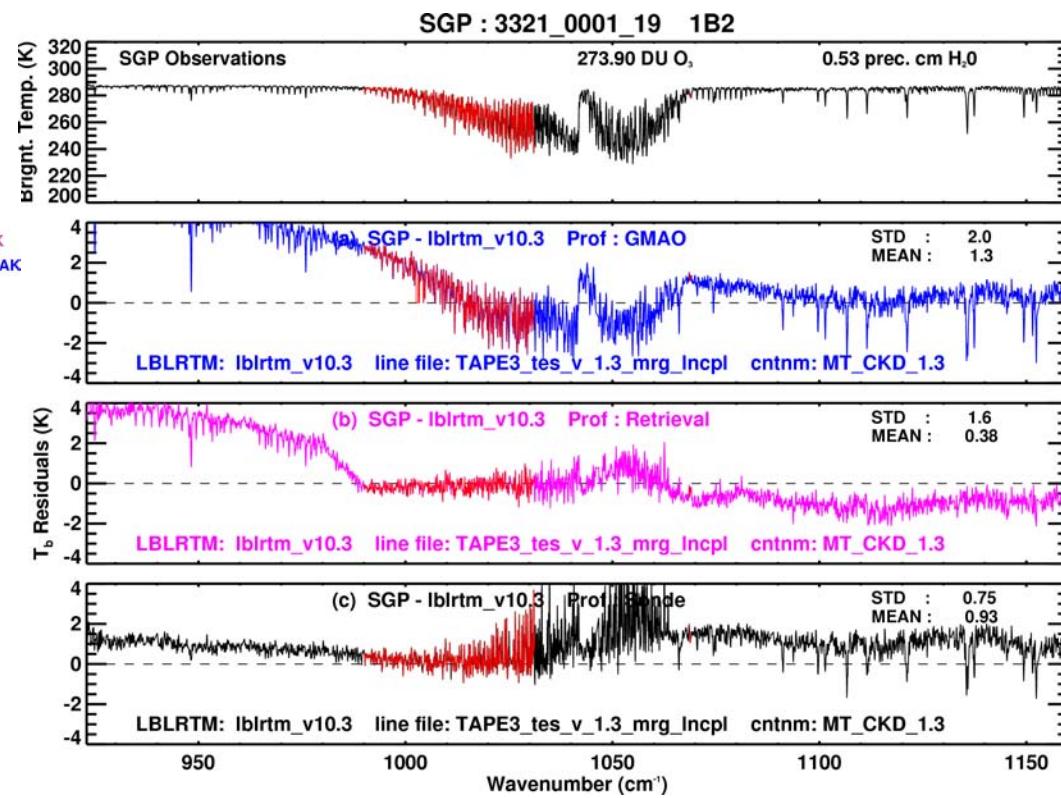
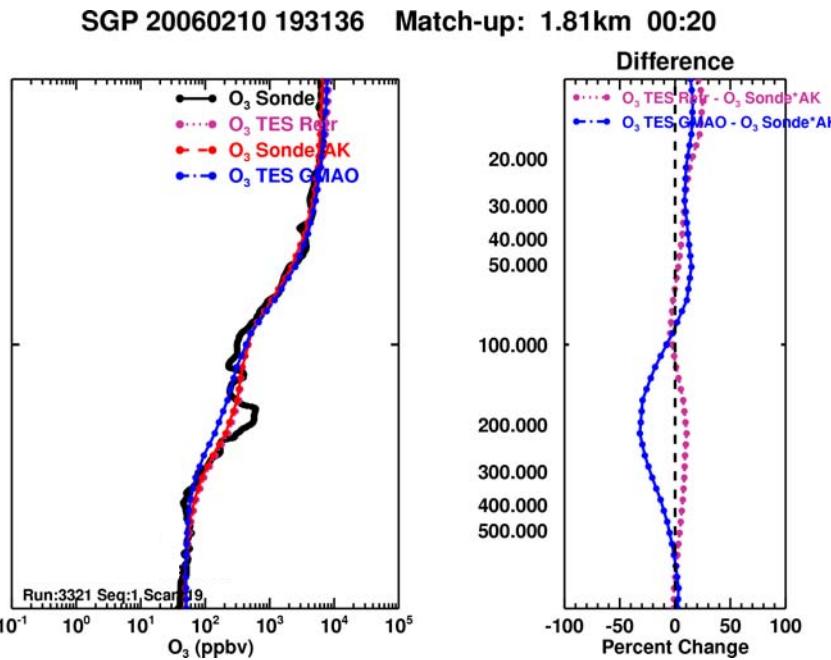
TES Water Vapor

- Retrieved water vapor residuals are good
- Large positive residuals (Obs.-Calc) in stronger water vapor lines from the sonde profile
 - Mid-to-upper troposphere: need to \uparrow calc. radiance, therefore \downarrow the water vapor
 - Indicates that the sonde water vapor is not representative of the true atm. state being observed



TES Ozone

- The ozone residuals (Obs. - Calc.) from retrieved profile are fairly good
- The ozone residuals are not as representative
- Retrieved surface emissivity and temperature look good in microwindows
- Remains some systematic errors in the ozone residuals

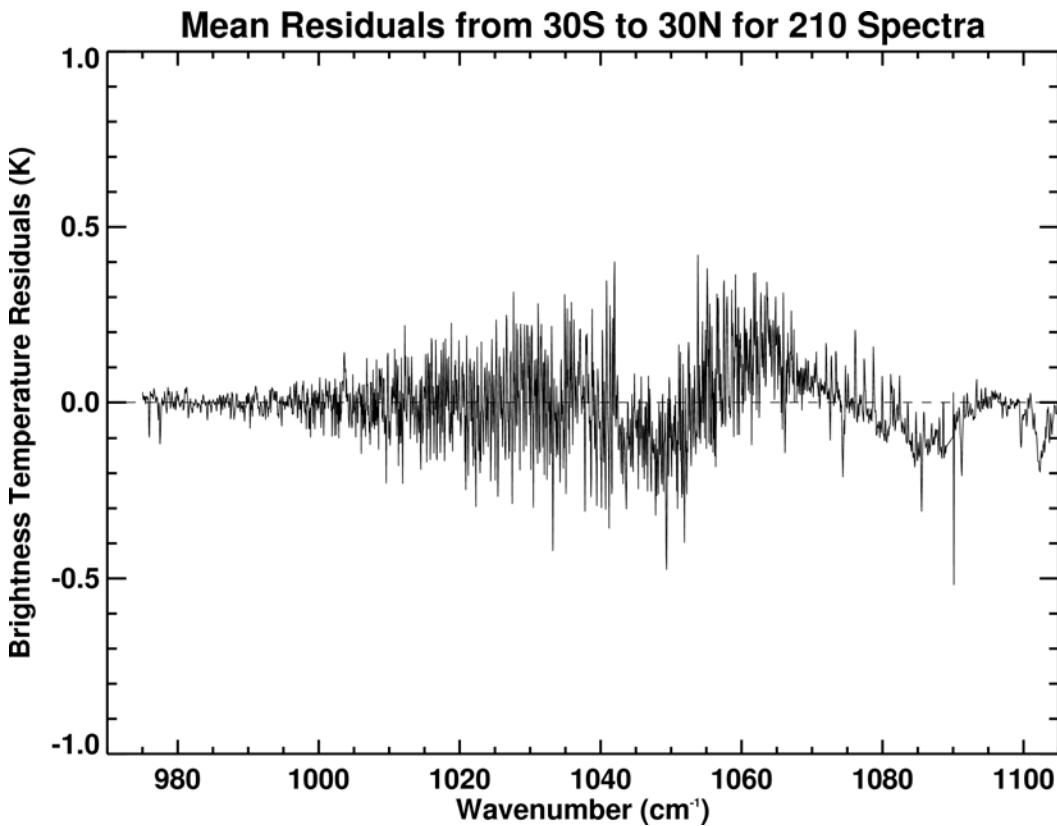


TES Mean Ozone Residuals

Reinhard Beer, JPL

Method

- After T_{ATM} , H_2O , O_3 retrieval step
- Removed data with:
 - CLOUD optical depth > 0.5
 - radiance residual mean > 0.3
 - radiance residual rms > 2.0
 - Latitudes > 30S and 30N
- Mean Residuals (observed – fit) for TES global survey 2147
- Mean of 210 spectra



Remarks

- Validating retrieved profile values with sondes can be challenging
 - Coincidence, co-location, measurement errors (i.e water vapor)
 - **Don't stop the validation process here!**
- Comparison of forward model radiances with quality observations provides addition information for validating retrievals

Forward Radiances

Retrieved Profile
Sonde Profile



Observed Radiances

Well Calibrated : High SNR

- » Systematic errors in the retrieval (line parameters) or observations (calibration)

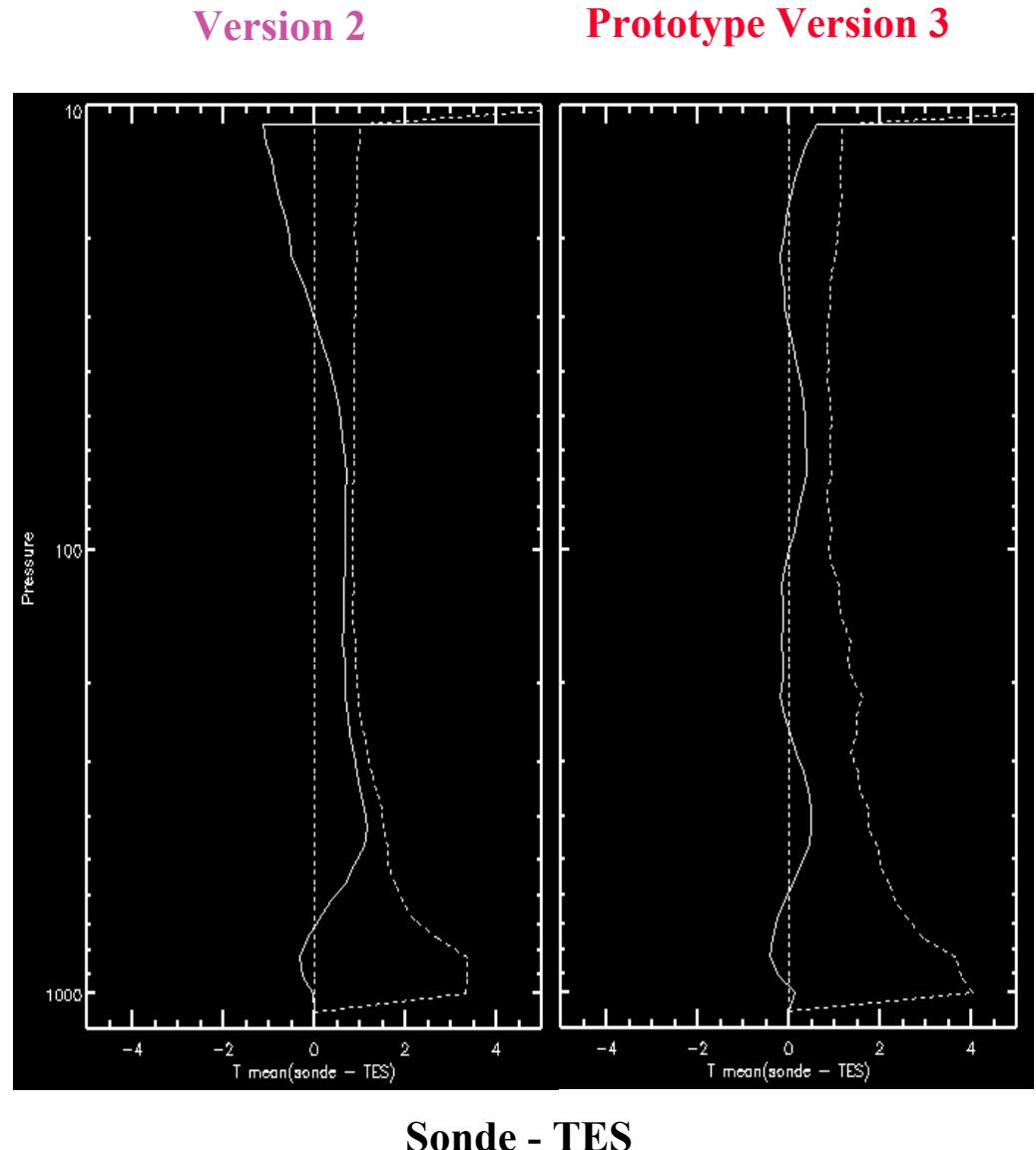
- Presented an ARM SGP ozonesonde example

Backup Slides

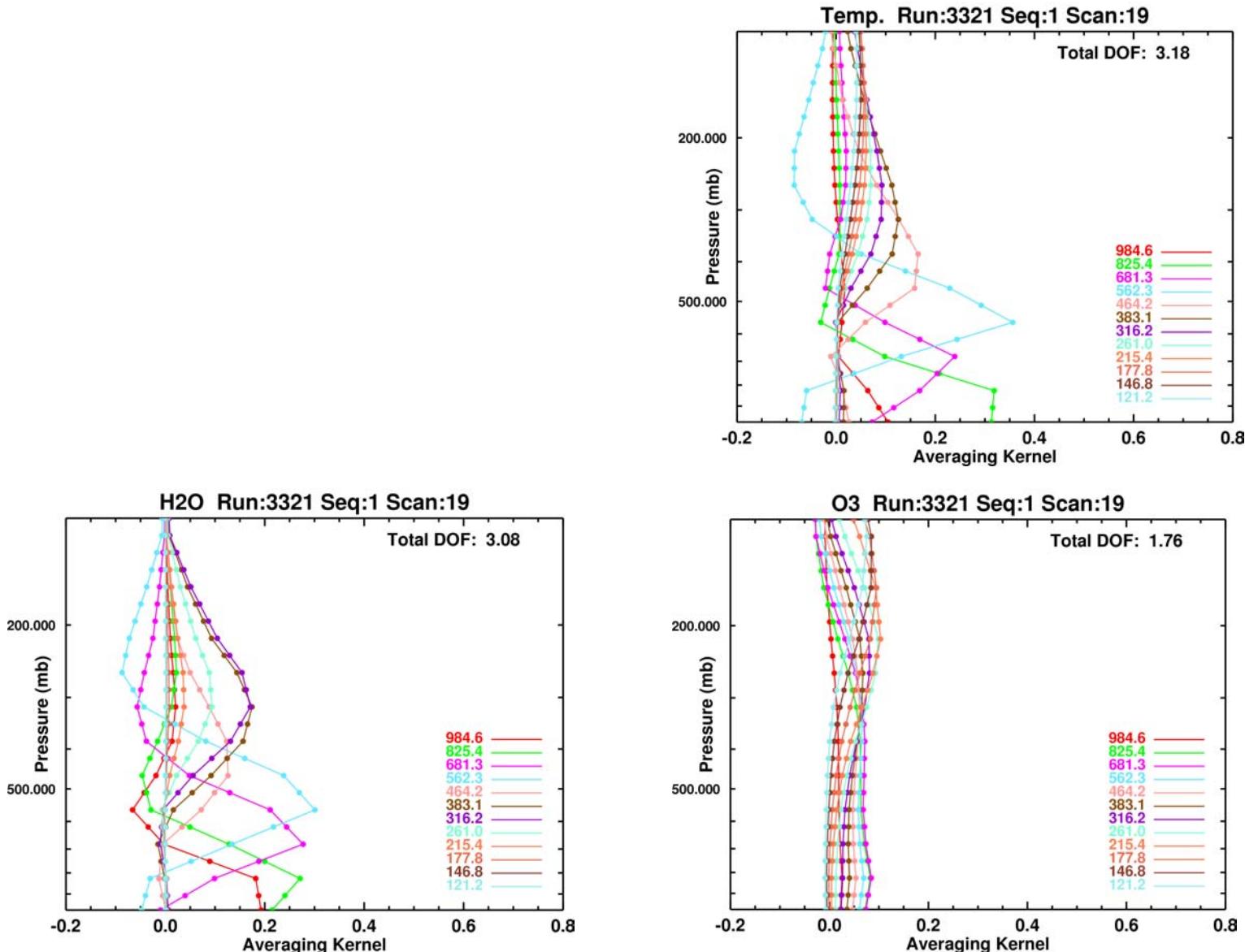
TES Temperature

Brendan Fisher, JPL

- Comparison of 190 NECP radiosondes during a TES global survey 3396
- Simultaneous temperature retrieval in prototype Version 3 includes the CO₂ spectral region (600 - 800 cm⁻¹)



TES Averaging Kernels: ARM SGP Example



TES Surface Emissivity : SGP ARM Example

